US010907397B1

(12) **United States Patent**
Jones

(10) **Patent No.: US 10,907,397 B1**
(45) **Date of Patent: Feb. 2, 2021**

(54) **DOOR OPENING ASSEMBLY FOR APPLIANCE**

(71) Applicant: **WHIRLPOOL CORPORATION**, Benton Harbor, MI (US)

(72) Inventor: **Christopher A. Jones**, St. Joseph, MI (US)

(73) Assignee: **Whirlpool Corporation**, Benton Harbor, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/569,687**

(22) Filed: **Sep. 13, 2019**

(51) **Int. Cl.**
E05F 15/63 (2015.01)
D06F 39/14 (2006.01)

(52) **U.S. Cl.**
CPC ***E05F 15/63*** (2015.01); ***D06F 39/14*** (2013.01); *E05Y 2900/312* (2013.01)

(58) **Field of Classification Search**
CPC D06F 37/10; D06F 37/18; D06F 37/28; D06F 39/14; D06F 2103/40; D06F 2105/44; A47L 15/4259; A47L 15/4261; E05F 15/63; E05F 15/603; E05F 2015/631; E05Y 2900/312
USPC ..... 134/57 DL, 58 DL; 68/12.26, 196; 49/275, 364
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,354,583	A *	11/1967	Moorman	E05B 17/0029 49/276
5,724,837	A	3/1998	Shin	
7,819,488	B2 *	10/2010	Lee	E05F 15/63 312/296
8,720,234	B2	5/2014	Kim et al.	
8,905,494	B2 *	12/2014	Kilic	A47L 15/488 312/228
9,556,552	B2	1/2017	Park et al.	
2015/0015001	A1	1/2015	Fabbro et al.	
2016/0116891	A1	4/2016	Megger et al.	
2016/0348919	A1	12/2016	Ivanovic et al.	
2017/0002504	A1	1/2017	Jung	
2019/0040654	A1	2/2019	Dirnberger et al.	

FOREIGN PATENT DOCUMENTS

DE	102011003818	A1 *	8/2012	A47L 15/4259
DE	102017213673	A1 *	2/2019	D06F 39/14
EP	1471201	A1 *	10/2004	E05F 15/63
EP	2497854	A1 *	9/2012	D06F 37/42

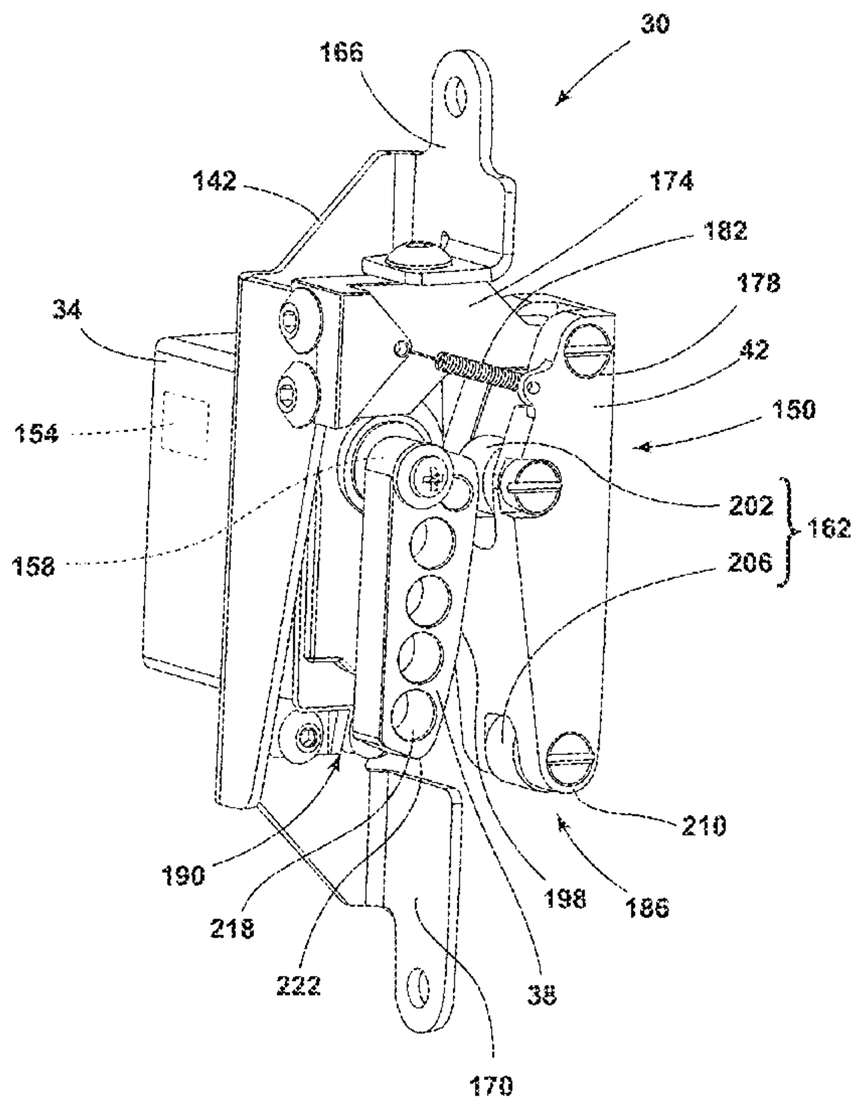
* cited by examiner

Primary Examiner — Andrew M Roersma
(74) *Attorney, Agent, or Firm* — Price Heneveld LLP

(57) **ABSTRACT**

A laundry appliance includes a cabinet and a door rotatably coupled to the cabinet. The door is operable between an opened position and a closed position. A door opening assembly is coupled to one of the cabinet and the door. The door opening assembly includes a motor coupled to a cam. The cam is operably coupled to an actuator arm.

12 Claims, 8 Drawing Sheets



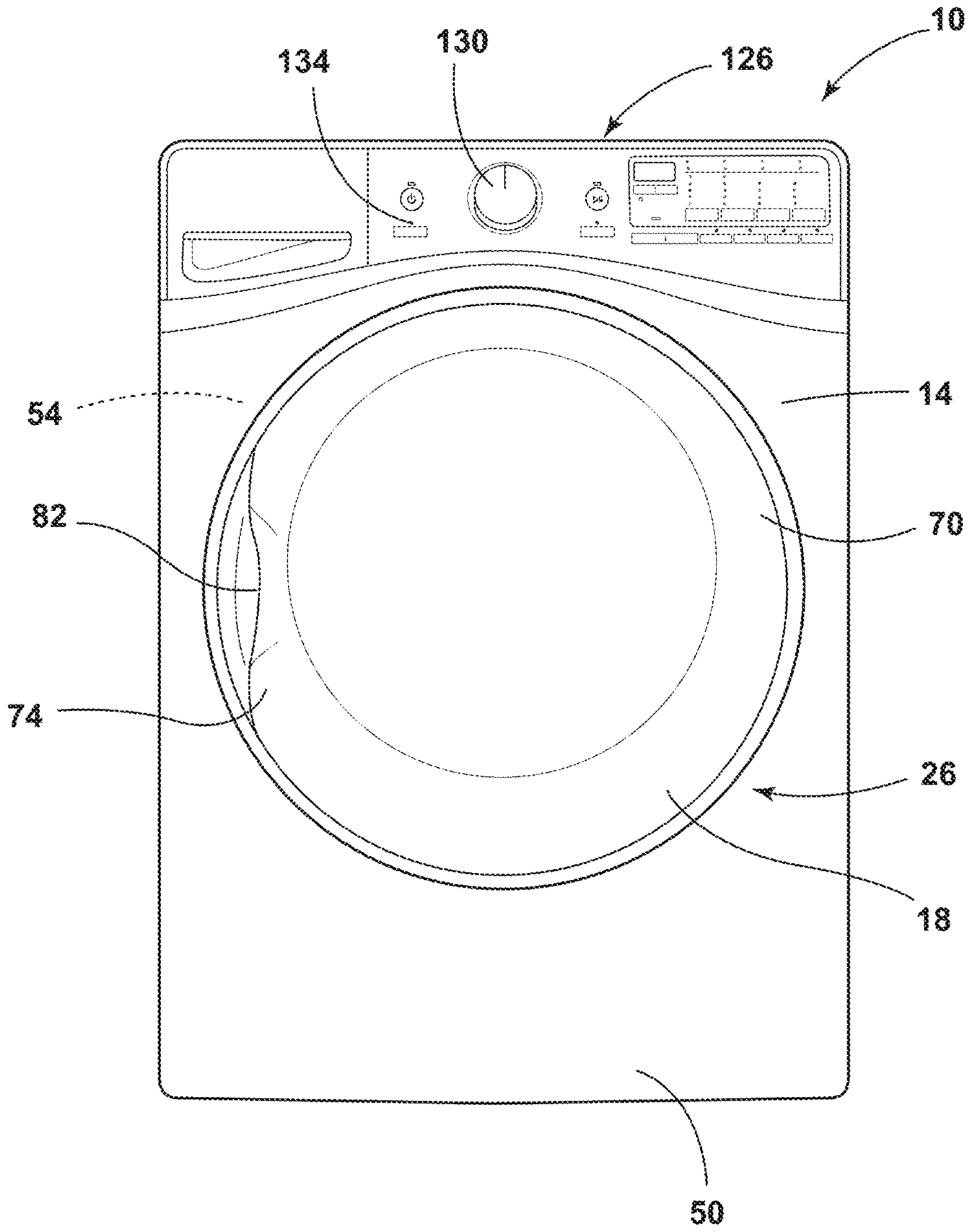


FIG. 1

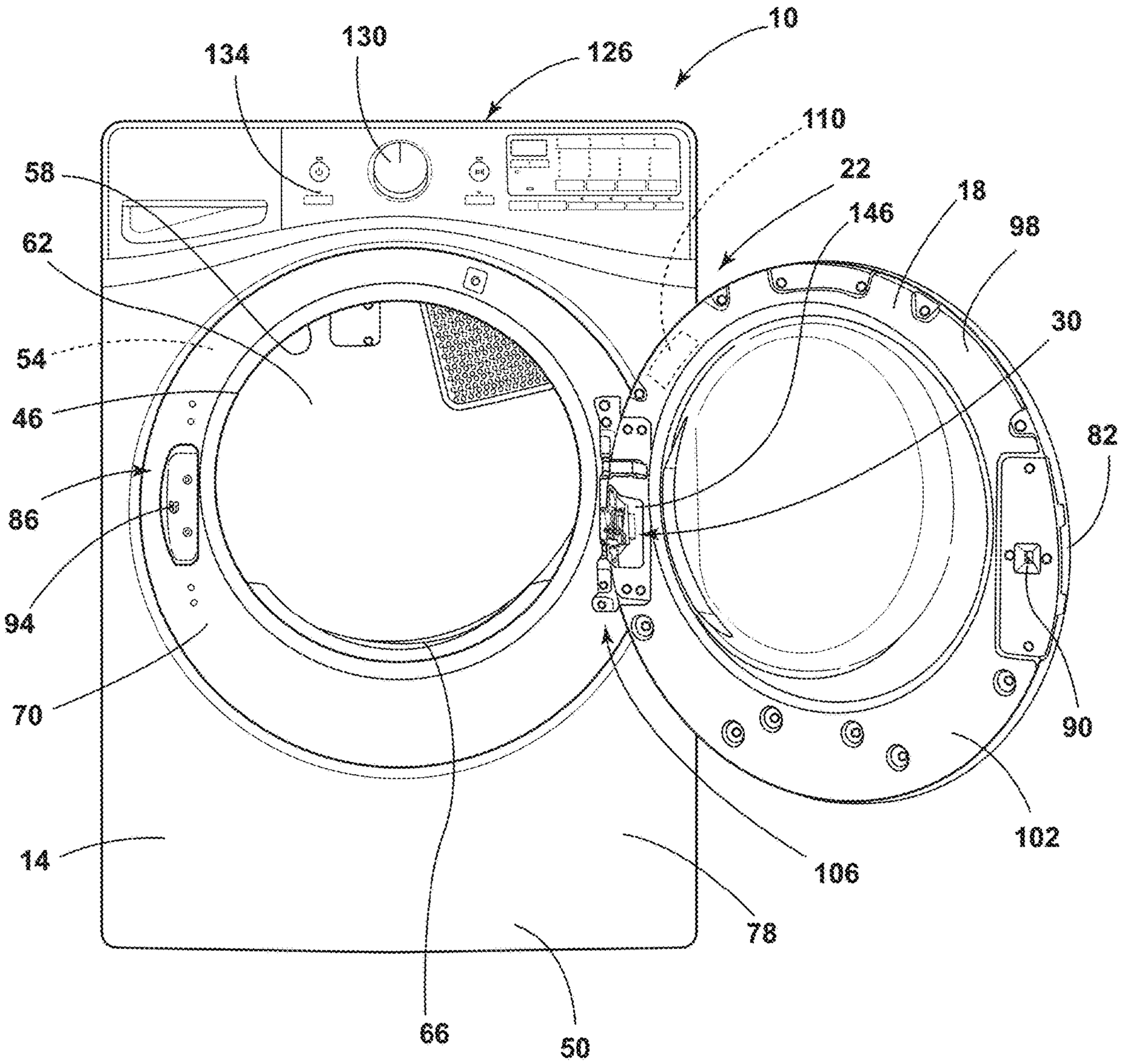

10
130
134
126
110
58
22
146
18
98
62
30
54
46
82
86
94
90
70
102
106
14
78
66
50

FIG. 2

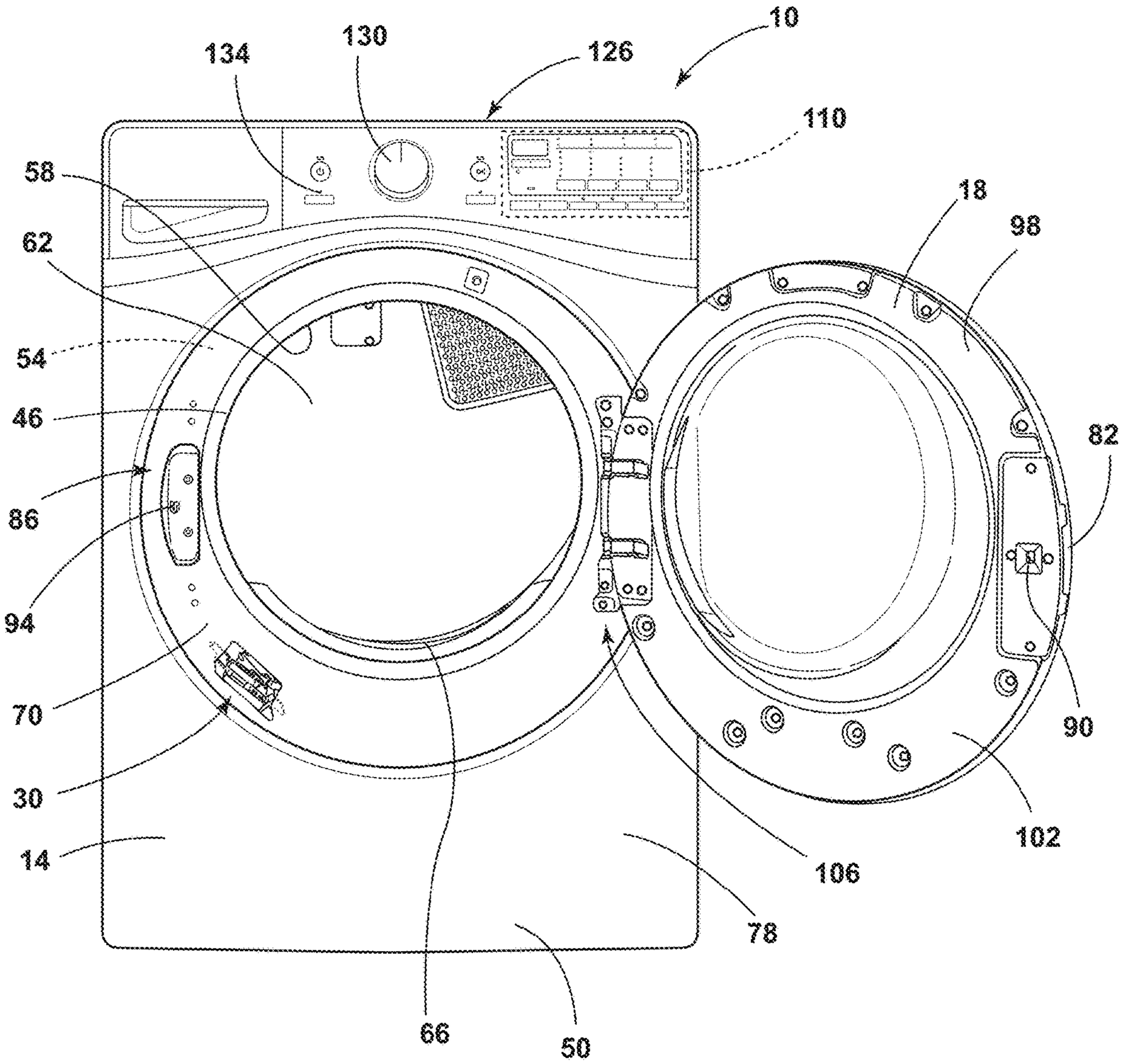

10
134
130
126
110
58
62
54
46
86
94
70
30
14
18
98
82
90
102
106
78
66
50

FIG. 3

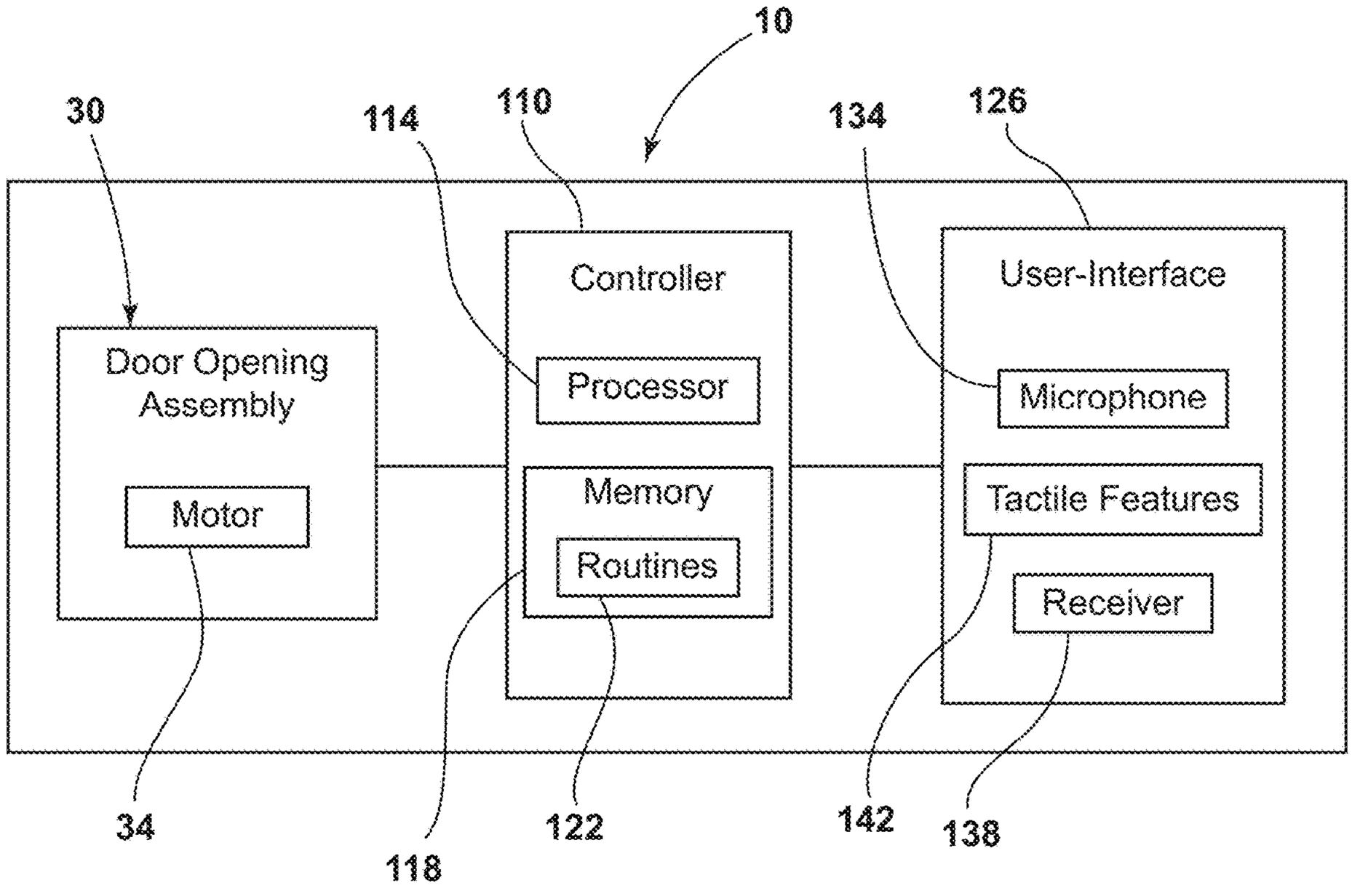

10
30
114
110
134
126
Controller
User-Interface
Door Opening Assembly
Processor
Microphone
Motor
Memory
Tactile Features
Routines
Receiver
34
118
122
142
138

FIG. 4

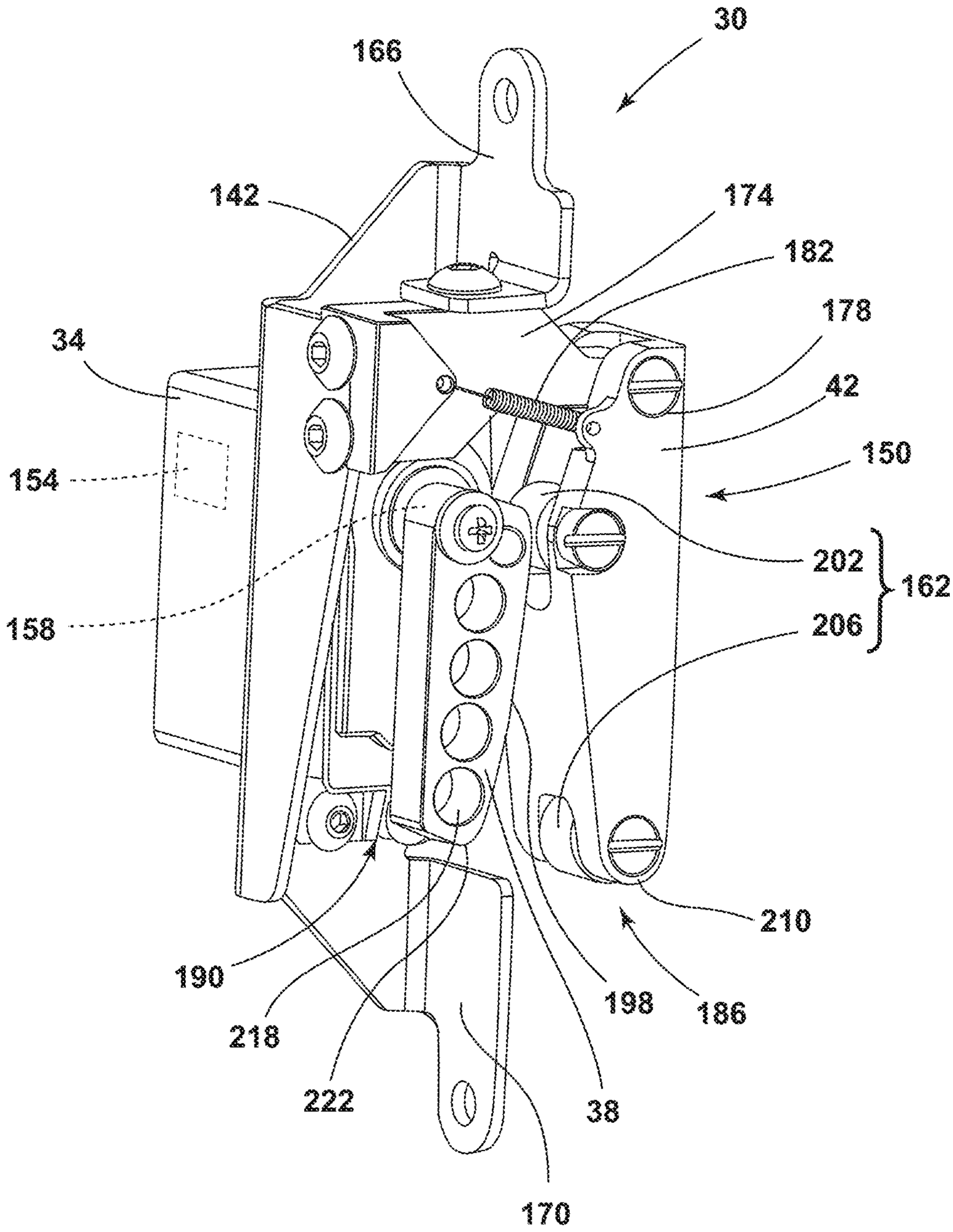

30
166
142
174
182
178
34
42
150
154
202
162
158
206
210
190
198
186
218
222
38
170

FIG. 5

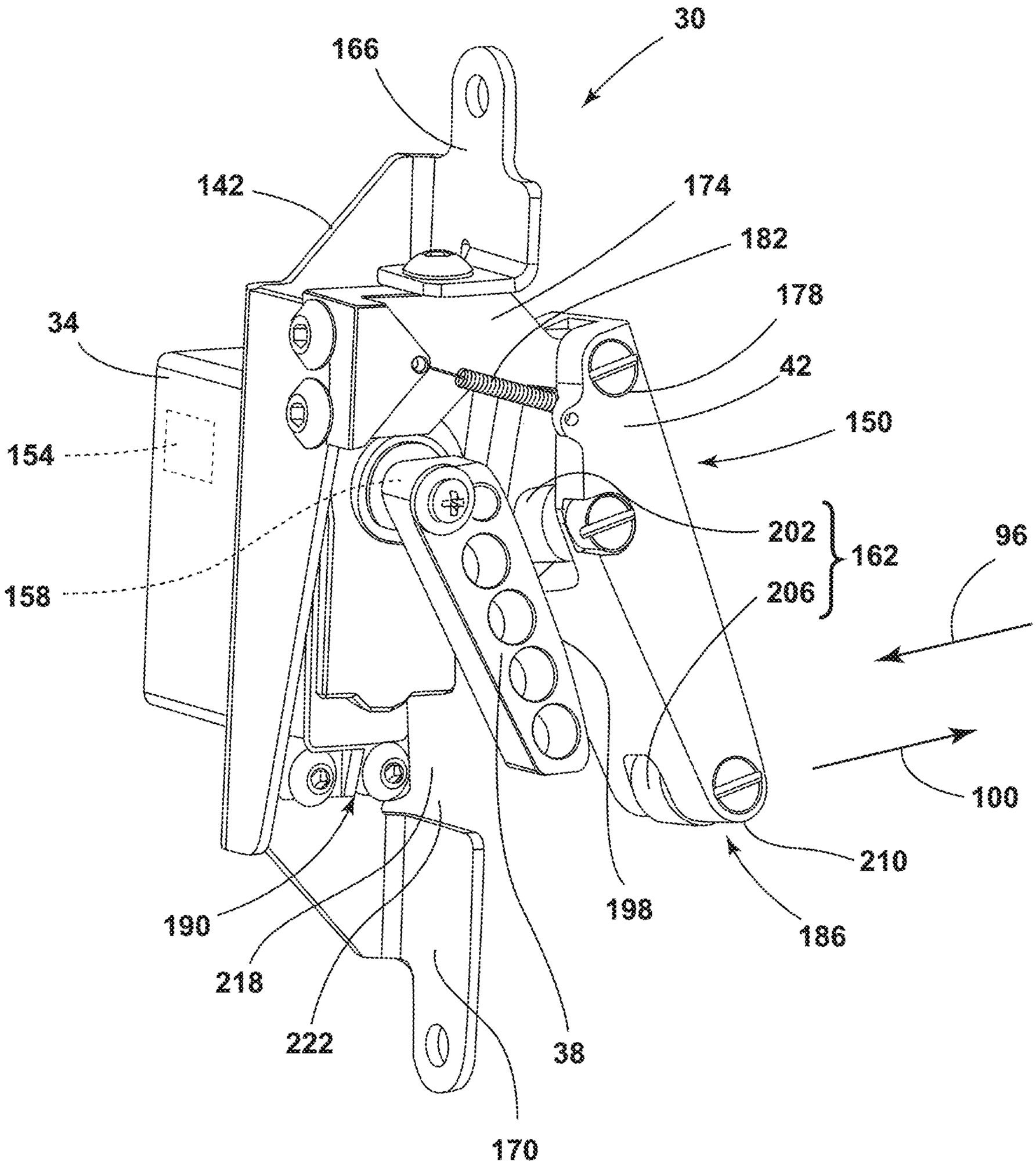

30
166
142
174
182
178
34
42
150
154
202
162
96
158
206
100
210
198
190
186
218
222
38
170

FIG. 6

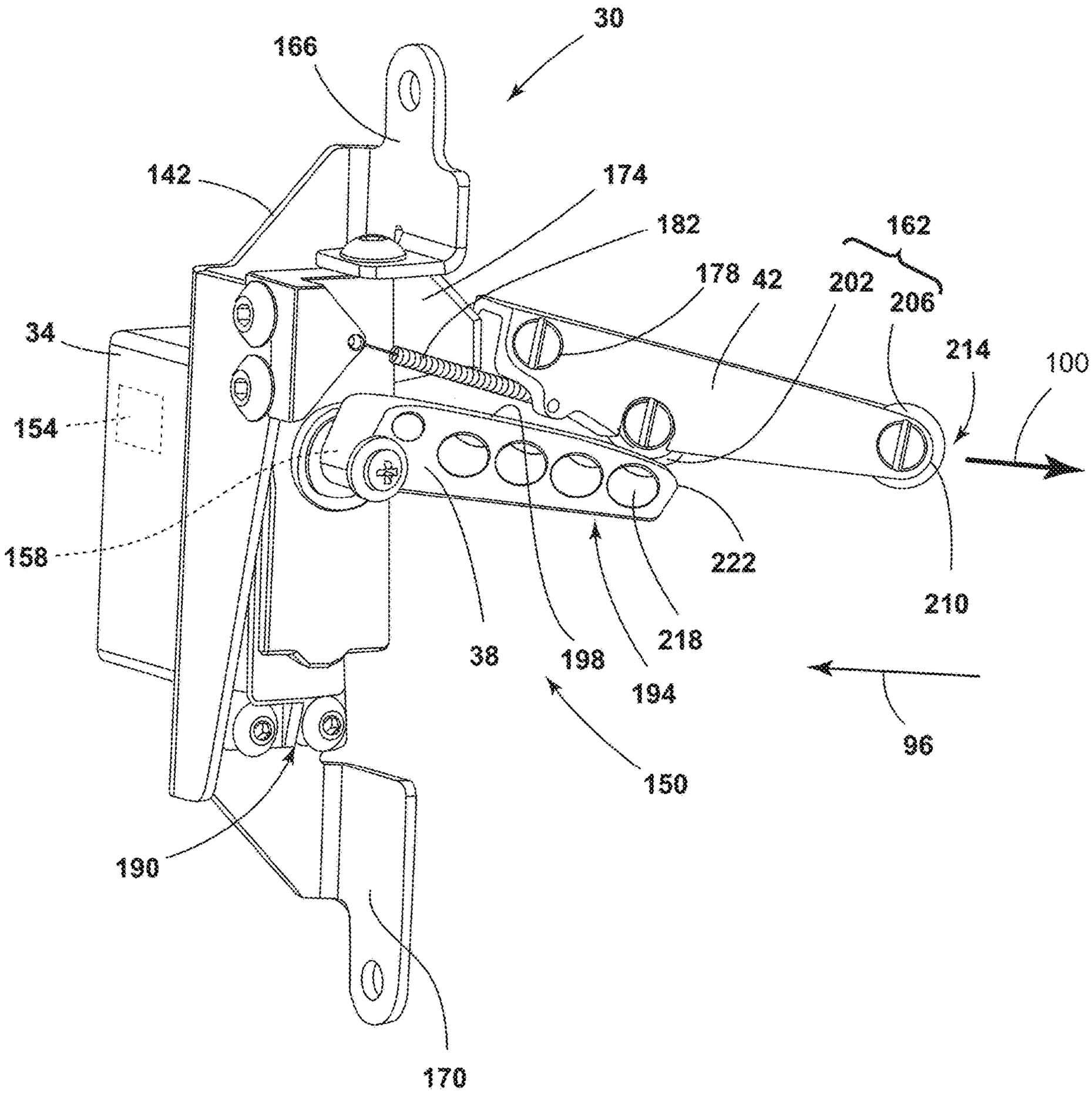

30
166
142
174
182
162
178
42
202
206
34
214
100
154
158
222
210
38
198
218
194
96
150
190
170

FIG. 7

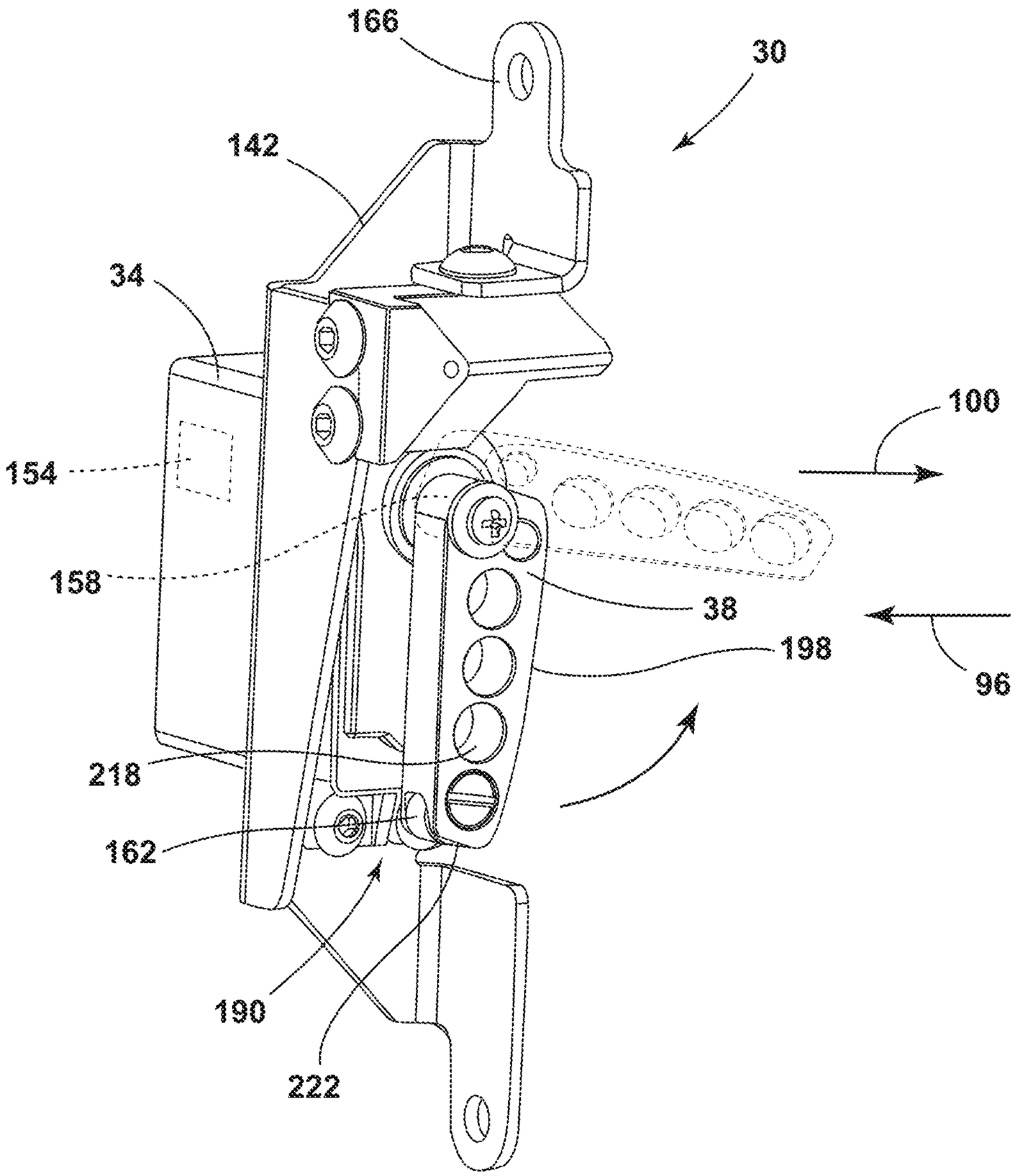


FIG. 8

DOOR OPENING ASSEMBLY FOR APPLIANCE

BACKGROUND OF THE DISCLOSURE

The present disclosure generally relates to a door opening assembly, and more specifically, to a door opening assembly for an appliance.

SUMMARY OF THE DISCLOSURE

According to one aspect of the present disclosure, a laundry appliance includes a cabinet and a door rotatably coupled to the cabinet. The door is operable between an opened position and a closed position. A door opening assembly is coupled to one of the cabinet and the door. The door opening assembly includes a motor coupled to a cam. The cam is operably coupled to an actuator arm.

According to another aspect of the present disclosure, a door opening assembly for an appliance includes a support member and a motor coupled to the support member. An actuating cam assembly is operably coupled to the motor. The actuating cam assembly includes a drive shaft that includes a cam and a follower. The motor rotates the drive shaft when activated.

According to yet another aspect of the present disclosure, a door opening assembly for an appliance includes a door panel and a support member coupled to the door panel. A motor is coupled to the support member. A cam is operably coupled to the motor. The motor rotates the cam to a predefined angle. An actuator arm is coupled to the support member. The actuator arm is rotated to a corresponding predefined angle by the cam. The actuator arm is configured to engage an engaging surface of a substrate.

These and other features, advantages, and objects of the present disclosure will be further understood and appreciated by those skilled in the art by reference to the following specification, claims, and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a front elevation view of a laundry appliance, according to the present disclosure;

FIG. **2** is a front elevation view of a laundry appliance with a door opening assembly on a door of the laundry appliance, according to the present disclosure;

FIG. **3** is a front elevation view of a laundry appliance with a door opening assembly on a cabinet of the laundry appliance, according to the present disclosure;

FIG. **4** is a block diagram of a laundry appliance, according to the present disclosure;

FIG. **5** is a side perspective view of a door opening assembly in a disengaged position, according to the present disclosure;

FIG. **6** is a side perspective view of the door opening assembly of FIG. **5** at least partially rotated toward an engaged position;

FIG. **7** is a side perspective view of the door opening assembly of FIG. **5** in an engaged position; and

FIG. **8** is a side perspective view of a door opening assembly in a disengaged position, according to this present disclosure.

The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles described herein.

DETAILED DESCRIPTION

The present illustrated embodiments reside primarily in combinations of method steps and apparatus components related to a door opening assembly for an appliance. Accordingly, the apparatus components and method steps have been represented, where appropriate, by conventional symbols in the drawings, showing only those specific details that are pertinent to understanding the embodiments of the present disclosure so as not to obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein. Further, like numerals in the description and drawings represent like elements.

For purposes of description herein, the terms "upper," "lower," "right," "left," "rear," "front," "vertical," "horizontal," and derivatives thereof shall relate to the disclosure as oriented in FIG. **1**. Unless stated otherwise, the term "front" shall refer to the surface of the element closer to an intended viewer, and the term "rear" shall refer to the surface of the element further from the intended viewer. However, it is to be understood that the disclosure may assume various alternative orientations, except where expressly specified to the contrary. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions and other physical characteristics relating to the embodiments disclosed herein are not to be considered as limiting, unless the claims expressly state otherwise.

The terms "including," "comprises," "comprising," or any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises a list of elements does not include only those elements but may include other elements not expressly listed or inherent to such process, method, article, or apparatus. An element proceeded by "comprises a . . . " does not, without more constraints, preclude the existence of additional identical elements in the process, method, article, or apparatus that comprises the element.

Referring to FIGS. **1-8**, reference numeral **10** generally designates a laundry appliance that includes a cabinet **14** and a door **18** rotatably coupled to the cabinet **14**. The door **18** is operable between an opened position **22** and a closed position **26**. A door opening assembly **30** is coupled to one of the cabinet **14** and the door **18**. The door opening assembly **30** includes a motor **34** coupled to a cam **38**. The cam **38** is operably coupled to an actuator arm **42**.

Referring to FIGS. **1** and **2**, the laundry appliance **10** includes the cabinet **14** that defines a front opening **46** in a front panel **50** thereof. A tub **54** is typically disposed within the cabinet **14** and defines an access opening **58** that aligns with the front opening **46** of the cabinet **14**. A drum **62** may be disposed within the tub **54** and may have an opening that aligns with the front opening **46** and the access opening **58**. Accordingly, the drum **62** is accessible by a user via the front opening **46** and the access opening **58**. The laundry appliance **10** is illustrated as a front-load washer, however, the laundry appliance **10** may also be a top-load washer, a dryer, a combination washer/dryer, or other laundry appliance **10**. Further, this disclosure is not limited to laundry appliances **10**. The door opening assembly **30** may be included in other appliances, such as, for example, refrigerators, freezers, coolers, vacuum insulated structures, storage structures, and other similar appliances and fixtures within household and commercial settings.

In various aspects, the door **18** is operably coupled to the cabinet **14** for alternately sealing and providing access to the front opening **46**. In this way, when the door **18** is in the closed position **26**, the front opening **46** may be sealed. When the door **18** is in the opened position **22**, the user may access the drum **62** through the front opening **46**. As illustrated, the door **18** may be a swing door **18** rotatably coupled to the cabinet **14**. In such examples, the door **18** may be a flat panel door or a fishbowl-style door. As illustrated in FIGS. **1** and **2**, the door **18** opens in a side-to-side manner, however, it is contemplated that the door **18** may open in an up-and-down manner.

According to various aspects, the laundry appliance **10** may include a bellows assembly **66** disposed adjacent to the front opening **46** of the cabinet **14**. The bellows assembly **66** may extend between the cabinet **14** and the tub **54**. The bellows assembly **66** may prevent items within the drum **62** (e.g., laundry) from moving from the drum **62** into the cabinet **14**. In various examples, the tub **54** and the drum **62** may be positioned at an angle within the cabinet **14**. As such, the access opening **58** may be offset from the front opening **46**. Accordingly, the bellows assembly **66** may be an obliquely-oriented bellows assembly **66**. The bellows assembly **66** can be configured to form an oblique cylinder or frusto-conical shape that defines a downward angle between the front opening **46** and the offset tub **54**. The bellows assembly **66** may be advantageous for retaining laundry within the tub **54** during a laundry cycle.

Referring still to FIGS. **1** and **2**, the front panel **50** may define a recess **70** around the front opening **46**. The door **18** may be coupled to the cabinet **14** within the recess **70**. When the door **18** is in the closed position **26**, an outer surface **74** of the door **18** may be flush with a front panel surface **78** of the cabinet **14**. It is also contemplated that the outer surface **74** may be offset from the front panel surface **78**. Additionally or alternatively, the door **18** may include a handle **82**. The door **18** may curve away from the front panel surface **78** to define a gap therebetween, which may define the handle **82**. In this way, the gap may provide space for the hand of the user between the door **18** and the recess **70** to grasp the handle **82**.

In various examples, the laundry appliance **10** may include a latch assembly **86** to retain the door **18** in the closed position **26**. The latch assembly **86** may include a striker **90** and a strike plate **94**. An engagement between the striker **90** and the strike plate **94** typically retains the door **18** in the closed position **26** when the laundry appliance **10** is in operating and non-operating conditions. When engaged, the striker **90** and the strike plate **94** produce a latch force **96** sufficient to retain the door **18** in the closed position **26**. To open the door **18**, an opening force **100** can be applied to the door **18** and/or the cabinet **14** of the laundry appliance **10** that overcomes the latch force **96** of the latch assembly **86**.

Referring to FIGS. **2** and **3**, the door opening assembly **30** may be coupled to the laundry appliance **10** in a variety of locations. The door opening assembly **30** may be configured to apply the opening force **100** sufficient to overcome the latch force **96** of the latch assembly **86** to open the door **18**. As illustrated in FIG. **2**, the door opening assembly **30** may be coupled to the door **18**. In such examples, the door **18** may include a door panel **98** in which the door opening assembly **30** is coupled. The door opening assembly **30** may be disposed on an inner surface **102** of the door **18** proximate a hinge assembly **106** that is rotatably coupled to door **18** to the cabinet **14**. Additionally or alternatively, the door opening assembly **30** may be disposed proximate the striker **90**. In this way, the door opening assembly **30** may apply the opening force **100** to the front panel surface **78** proximate the latch assembly **86**. When the door opening assembly **30** is disposed on the door **18**, the door opening assembly **30** is configured to apply the opening force **100** to the front panel surface **78** to overcome the latch force **96** of the latch assembly **86**. It is contemplated that the door opening assembly **30** may be disposed in any practicable location on the door **18**.

As illustrated in FIG. **3**, in an additional and/or alternative example, the door opening assembly **30** may be coupled to the cabinet **14**. In such examples, the door opening assembly **30** may be disposed on the front panel **50** within the recess **70**. In this way, the door opening assembly **30** may apply the opening force **100** to the inner surface **102** of the door **18** to overcome the latch force **96** of the latch assembly **86**. The door opening assembly **30** is illustrated proximate the latch assembly **86**. However, it is contemplated that the door opening assembly **30** may be disposed in any practicable location on the cabinet **14**.

Referring still to FIGS. **2** and **3**, the door opening assembly **30** may be operably coupled to a controller **110**. The controller **110** may be disposed on the door **18**, as illustrated in FIG. **2**, or may be disposed on the cabinet **14**, as illustrated in FIG. **3**. According to various aspects, when the door opening assembly **30** is disposed on the door **18**, the controller **110** may also be disposed on the door **18**. When the door opening assembly **30** may be disposed on the cabinet **14**, the controller **110** may also be disposed on the cabinet **14**. However, it is also contemplated that when the door opening assembly **30** is disposed on the door **18**, the controller **110** is disposed on the cabinet **14**. It is further contemplated that when the door opening assembly **30** is disposed on the cabinet **14**, the controller **110** may be disposed on the door **18**. Additionally or alternatively, the laundry appliance **10** may include more than one controller **110**. In such examples, at least one controller **110** may be disposed on the cabinet **14** and at least one controller **110** may be disposed on the door **18**.

Referring to FIG. **4**, the controller **110** may include a processor **114**, other control circuitry, and a memory **118**. Instructions or routines **122** may be included in the memory **118** and are executable by the processor **114**. In various aspects, the laundry appliance **10** may include a user-interface **126** for the user to input a command into the laundry appliance **10**. The user-interface **126** may include tactile features **130**, such as, for example, a button, a switch, a touch panel, or other similar features. The tactile features **130** may allow the user to physically input a command into the laundry appliance **10**. Additionally or alternatively, the user-interface **126** may include a microphone **134**. The microphone **134** may be configured to receive a voice command from the user. In this way, the user may give a remote command to the laundry appliance **10**. Additionally or alternatively still, the user-interface **126** may include a receiver **138**. In various examples, the user may use an electronic device (e.g., a phone, a tablet, a computer, etc.) to input a command that may be received by the receiver **138** of the user-interface **126**. This may provide an additional and/or alternative method for the user to input a remote command into the laundry appliance **10**. The user-interface **126** may send a signal relating to the user command to the controller **110**. The controller **110** may then send a corresponding signal to the door opening assembly **30**. In examples where the controller **110** and/or the door opening assembly **30** are disposed on the door **18**, an electrical

connection may be provided between the cabinet **14** and the door **18** to supply power to the controller **110** and/or the door opening assembly **30**.

Referring to FIGS. **2**, **3**, and **5**, the door opening assembly **30** may include a support member **142** for coupling the door opening assembly **30** to the front panel **50** (FIG. **3**) and/or the door panel **98** (FIG. **2**). The motor **34** may be coupled to the support member **142**. In various examples, the laundry appliance **10** may define a motor cavity for receiving the door opening assembly **30**. In such examples, the motor **34** may be disposed within the motor cavity. Alternatively, the laundry appliance **10** may include a bracket **146**. In such examples, the support member **142** may be coupled to the bracket **146** and the motor **34** may be disposed proximate the bracket **146**.

According to various aspects, the door opening assembly **30** may include an actuating cam assembly **150**. The actuating cam assembly **150** may be operably coupled to the motor **34** such that the motor **34** may be configured to rotate the actuating cam assembly **150**. The actuating cam assembly **150** may include a drive shaft **158** that may include the cam **38**. In additional examples, the cam **38** may be integrally formed with the drive shaft **158**. Alternatively, the cam **38** may be a separate feature coupled to the drive shaft **158**. According to various aspects, the actuating cam assembly **150** may include the actuator arm **42** operably coupled to the cam **38**. The actuator arm **42** may be coupled to the support member **142**. Additionally or alternatively, the actuating cam assembly **150** may include at least one follower **162**. In a non-limiting example, the motor **34** may be configured as a servo motor **34**. In such examples, the servo motor **34** may provide for control of the actuating cam assembly **150** to define the angular positions and movement of the actuating cam assembly **150**. The motor **34** may be coupled to a sensor **154** that may provide feedback regarding a rotational position of the actuating cam assembly **150** of the motor **34**.

Referring still to FIG. **5**, the support member **142** may have a generally C-shaped structure. In this way, the motor **34** may be coupled to the support member **142** between first and second arms **166**, **170** of the support member **142**. Additionally or alternatively, the cam **38** may be disposed between the first and second arms **166**, **170**. In this configuration, the support member **142** is positioned to not interfere with rotation of the cam **38** by the motor **34**. In various examples, the first and second arms **166**, **170** are configured to couple to the laundry appliance **10**. The first arm **166** may include an extension **174** coupled to the actuator arm **42**. The extension **174** may be disposed proximate the first arm **166** and arranged to not interfere with the coupling of the door opening assembly **30** to the laundry appliance **10**. The extension **174** may be coupled to a proximal end **178** of the actuator arm **42**.

A biasing member **182** may be coupled between the extension **174** and the actuator arm **42**. The biasing member **182** may bias the actuator arm **42** to a disengaged position **186**. When in the disengaged position **186**, the actuator arm **42** may be spaced-apart from an engaging surface (e.g., one of the front panel surface **78** and the inner surface **102** (FIG. **2**) of a substrate (e.g., one of the cabinet **14** and the door **18**). As illustrated in FIG. **5**, when in the disengaged position **186**, the actuator arm **42** may have an orientation that is generally parallel with the engaging surface. Based on the arrangement of the door opening assembly **30** and/or the location of the door opening assembly **30** on the laundry appliance **10**, the disengaged position **186** may be a substantially vertical orientation, a substantially horizontal orientation, and/or an angled orientation therebetween.

Referring to FIGS. **5-7**, the motor **34** may be configured to rotate the cam **38** between first and second positions **190**, **194** when activated. When in the first position **190**, the cam **38** may be in a generally parallel configuration with respect to the engaging surface and proximate to the actuator arm **42**, which may also be in the generally vertical orientation. The cam **38** and the actuator arm **42** may be spaced-apart from one another, or alternatively, may be engaged with one another. The motor **34** may rotate the drive shaft **158**, and accordingly, the cam **38** toward the actuator arm **42**. As the cam **38** rotates, a surface **198** of the cam **38** may engage the actuator arm **42**. In various examples, the surface **198** may be curved or sloped to allow the follower **162** to roll along the surface **198**. The actuator arm **42** may include a first follower **202** and a second follower **206**. The first follower **202** may be coupled to the proximal end **178** of the actuator arm **42** and the second follower **206** may be coupled to a distal end **210** of actuator arm **42**.

As the cam **38** rotates, the surface **198** may engage the first follower **202**. The curved or sloped configuration of the surface **198** may assist the first follower **202** in rolling or otherwise moving along the surface **198**. The rotation of the cam **38** may cause the actuator arm **42** to move from the disengaged position **186** toward an engaged position **214**. The cam **38** may be rotated to the second position **194**, which may be defined as a predefined angle. The predefined angle may be any angle depending on the configuration of the laundry appliance **10**. In a non-limiting example, the predefined angle may be in a range of from about 75° to about 125° relative to the first position **190**. The cam **38** may engage the actuator arm **42** and overcome a biasing force of the biasing member **182**. In this way, the rotation of the cam **38** to the predefined angle may rotate or otherwise move the actuator arm **42** to a corresponding predetermined angle. According to various aspects, once the cam **38** reaches the predefined angle and the actuator arm **42** reaches the corresponding predefined angle, the cam **38** may be in the second position **194** and the actuator arm **42** may be in the engaged position **214**.

Additionally or alternatively, the cam **38** may define one or more apertures **218**. The apertures **218** may decrease a weight of the cam **38**. In this way, the apertures **218** may contribute to an increased speed of rotation of the cam **38** by the motor **34**. It may be advantageous for the cam **38** to define the apertures **218** to increase the speed of rotation of the cam **38** to generate an increased opening force **100**. Additionally or alternatively, the decreased weight of the cam **38** may be advantageous for when the motor **34** is less powerful.

The motor **34** may rotate the cam **38** to the first position **190**. As the cam **38** returns to the first position **190**, the biasing member **182** may act on the actuator arm **42**. In this way, the biasing force acts on the actuator arm **42** to return the actuator arm **42** to the disengaged position. The cam **38** may return to the first position **190** after a predetermined amount of time, by user command, or a combination thereof.

Referring to FIGS. **2**, **3**, and **8**, in an additional or alternative configuration of the door opening assembly **30**, the door opening assembly **30** may not include the actuator arm **42**. In this way, the follower **162** may be coupled to an end **222** of the cam **38** opposite the drive shaft **158**. In such examples, the motor **34** may rotate the cam **38** from the first position **190** to the second position **194**. The follower **162** may be configured to engage one of the front panel **50** and the door panel **98**, depending on the location of the door

opening assembly **30** on the appliance **10**. This configuration may be advantageous where a more powerful motor **34** is used in the door opening assembly **30**. The motor **34** may be configured to rotate the cam **38** at a speed and/or with the opening force **100** sufficient to overcome the latch force **96** of the latch assembly **86**.

Referring to FIGS. **1**, **2**, and **4-7**, the user may input a command to the laundry appliance **10** via the user-interface **126**. The user-interface **126** may send a signal to the controller **110**. The controller **110** may send a corresponding signal to the door opening assembly **30**. In this way, the motor **34** may be activated via the command (e.g., a remote command) to the controller **110**. When activated, the motor **34** may rotate the drive shaft **158**, which may correspondingly rotate the cam **38**. The cam **38** may be operable between the first and second positions **190**, **194**.

According to various aspects, a default position of the cam **38** may be the first position **190**. The motor **34** may rotate the cam **38** toward the second position **194**. As the cam **38** rotates, the surface **198** of the cam **38** may engage the first follower **202** coupled to the actuator arm **42**. The cam **38** may overcome the biasing force of the biasing member **182** to move or rotate the actuator arm **42**. The actuator arm **42** may be operable between disengaged and engaged positions **186**, **214**. The biasing member **182** may bias the actuator arm **42** toward the disengaged position **186**. As such, the cam **38** may overcome the biasing force to move or rotate the actuator arm **42**. The motor **34** may rotate the cam **38** to the predefined angle that defines the second position **194**. The first follower **202** may roll along the surface **198** of the cam **38** until the cam **38** is in the second position **194** and the actuator arm **42** is in the engaged position **214**.

As the actuator arm **42** rotates, the second follower **206** may engage the front panel surface **78** of the front panel **50** of the laundry appliance **10**. Use of the cam **38** and the actuator arm **42** may operate as a force multiplier. Additionally or alternatively, the rotation of the cam **38** and the actuator arm **42** may apply the opening force **100** to the front panel surface **78** sufficient to overcome the latch force **96** of the latch assembly **86**. In this way, the door opening assembly **30** may open the door **18** to an ajar position where the latch assembly **86** is disengaged. In the ajar position, the door **18** can be opened with minimal effort on the part of the user. Rotation of the cam **38** to the predefined angle and the actuator arm **42** to the corresponding predefined angle, may define a distance in which the door **18** is opened relative to the cabinet **14**. Stated differently, the door opening assembly **30** may open the door **18** a predetermined distance based on the geometry and/or configuration of the cam **38** and actuator arm **42**. In such an embodiment, the curvature of the cam **38** may produce the force multiplier effect that can be useful in generating the opening force **100** that overcomes the latch force **96**.

Referring to FIGS. **2-8**, in examples of the door opening assembly **30** that may not include the actuator arm **42**, the door opening assembly **30** may operate in a substantially similar manner. In such examples, the motor **34** may rotate the cam **38** until the follower **162** contacts and/or engages the front panel **50**. The cam **38** may then apply the opening force **100** to the front panel **50** so to overcome the latch force **96** of the latch assembly **86**. The cam **38** may then continue to rotate to the second position **194** to open the door **18** the predetermined distance relative to the cabinet **14**.

Referring to FIGS. **3-7**, when the door opening assembly **30** is disposed on the cabinet **14**, the door opening assembly **30** may operate in a similar manner as to when the door opening assembly **30** is disposed on the door **18**. In such examples, as the actuator arm **42** rotates, the second follower **206** may engage the door panel **98** of the door **18**. The cam **38** and the actuator arm **42** may rotate and apply the opening force **100** to the door **18** sufficient to overcome the latch force **96** of the latch assembly **86**. The cam **38** and the actuator arm **42** may rotate to open the door **18** to the predetermined distance. According to various aspects, in examples where the door opening assembly **30** may not include the actuator arm **42** and the door opening assembly **30** is disposed on the cabinet **14** (FIGS. **3** and **8**), the follower **162** coupled to the cam **38** may engage the door panel **98**. The motor **34** may rotate the cam **38** such that the cam **38** applies the opening force **100** to the door **18** sufficient to overcome the latch force **96**.

Referring to FIGS. **1-8**, in operation, the motor **34** may rotate the cam **38** to the predefined angle. The motor **34** may include software, such as commands and instructions that define the predefined angle to which the cam **38** is rotated. The motor **34** may be communicatively coupled with the sensor **154**. The sensor **154** may sense the position of the cam **38** and/or the actuator arm **42**. The feedback from the sensor **154** may allow the motor to rotate the cam **38** to the predefined angle. The motor **34** may also include software relating to the distance the door **18** opens relative to the cabinet **14** and/or the rate of rotation of the cam **38**. Additionally or alternatively, the controller **110** may include specific routines **122** relating to the predefined angle the cam **38** is rotated, the distance the door **18** is opened relative to the cabinet **14**, and/or the rate of rotation of the cam **38**.

Use of the present disclosure may provide a variety of advantages. For example, the door opening assembly **30** may be activated via a remote command from the user. In this way, if the user is unable to open the door **18**, the door opening assembly **30** may open the door **18** for the user. Additionally, the door opening assembly **30** may be activated via a voice command or a command from an electronic device. Also, the door opening assembly **30** that includes the actuator arm **42** may utilize the actuator arm **42** as a force multiplier. This may be advantageous for use of different motors **34** in the door opening assembly **30** that may rotate the cam **38**, and accordingly, the actuator arm **42**, at different speeds and powers. Moreover, the door opening assembly **30** may be located in a variety of positions on the laundry appliance **10**, which may increase the aesthetics of the laundry appliance **10**. Further, the door opening assembly **30** may be a compact configuration, which may decrease space that the door opening assembly **30** uses on the laundry appliance **10**. Additionally, the compact configuration of the door opening assembly may reduce energy use of the laundry appliance **10** and may reduce manufacturing costs. Additional benefits or advantages of using this device may also be realized and/or achieved.

According to at least one aspect of the present disclosure, a laundry appliance includes a cabinet and a door rotatably coupled to the cabinet. The door is operable between an opened position and a closed position. A door opening assembly is coupled to one of the cabinet and the door. The door opening assembly includes a motor coupled to a cam. The cam is operably coupled to an actuator arm.

According to another aspect, a biasing member is coupled to an actuator arm. The actuator arm is biased towards a disengaged position.

According to yet another aspect, a cam engages an actuator and overcomes a biasing force of a biasing member to move the actuator arm to an engaged position.

According to still another aspect, an actuator arm is operable between a disengaged position and an engaged position.

According to another aspect, a door opening assembly is coupled to a cabinet. An actuator arm engages an inner surface of the door when in an engaged position.

According to still another aspect, a door opening assembly is coupled to a door. An actuator arm engages a front panel surface of a cabinet when in an engaged position.

According to yet another aspect, each of a cam and an actuator arm rotates to a predefined angle to open a door a predefined distance.

According to another aspect, an actuator arm includes at least one follower.

According to still another aspect, at least one follower includes a first follower coupled to a proximal end of an actuator arm and configured to engage a cam and a second follower coupled to a distal end of the actuator arm and configured to engage one of a door surface and a cabinet surface.

According to another aspect, an actuator includes a first follower that contacts a cam and a second follower that contacts a door.

According to still another aspect, a controller is operably coupled to the motor. The motor is activated via a remote command delivered to the controller.

According to at least one aspect of the present disclosure, a door opening assembly for an appliance includes a support member and a motor coupled to the support member. An actuating cam assembly is operably coupled to the motor. The actuating cam assembly includes a drive shaft that includes a cam and at least one follower. The motor rotates the drive shaft when activated.

According to another aspect, a door opening assembly includes a cabinet panel. A support member is coupled to the cabinet panel. An actuating cam assembly is configured to engage a door.

According to still another aspect, at least one follower is coupled to a distal end of a cam.

According to another aspect, an actuating cam assembly includes an actuator arm coupled to a support member.

According to yet another aspect, at least one follower includes a first follower coupled to a proximal end portion of an actuator arm and a second follower coupled to a distal arm portion of an actuator arm.

According to at least one aspect of the present disclosure, a door opening assembly for an appliance includes a door panel and a support member coupled to the door panel. A motor is coupled to the support member. A cam is operably coupled to the motor. The motor rotates the cam to a predefined angle. An actuator arm is coupled to the support member. The actuator arm is rotated to a corresponding predefined angle by the cam. The actuator arm is configured to engage an engaging surface of a substrate.

According to another aspect, a first follower is coupled to a proximal end portion of an actuator arm to engage a cam. A second follower is coupled to a distal end portion of the actuator arm to engage an engaging surface.

According to still another aspect, an actuator arm is operable between a disengaged position and an engaged position. The actuator arm is spaced-apart from an engaging surface when in the disengaged position.

According to yet another aspect, a controller is operably coupled to a motor. The motor is activated via a remote command to the controller.

It will be understood by one having ordinary skill in the art that construction of the described disclosure and other components is not limited to any specific material. Other exemplary embodiments of the disclosure disclosed herein may be formed from a wide variety of materials, unless described otherwise herein.

For purposes of this disclosure, the term "coupled" (in all of its forms, couple, coupling, coupled, etc.) generally means the joining of two components (electrical or mechanical) directly or indirectly to one another. Such joining may be stationary in nature or movable in nature. Such joining may be achieved with the two components (electrical or mechanical) and any additional intermediate members being integrally formed as a single unitary body with one another or with the two components. Such joining may be permanent in nature or may be removable or releasable in nature unless otherwise stated.

It is also important to note that the construction and arrangement of the elements of the disclosure as shown in the exemplary embodiments is illustrative only. Although only a few embodiments of the present innovations have been described in detail in this disclosure, those skilled in the art who review this disclosure will readily appreciate that many modifications are possible (e.g., variations in sizes, dimensions, structures, shapes and proportions of the various elements, values of parameters, mounting arrangements, use of materials, colors, orientations, etc.) without materially departing from the novel teachings and advantages of the subject matter recited. For example, elements shown as integrally formed may be constructed of multiple parts or elements shown as multiple parts may be integrally formed, the operation of the interfaces may be reversed or otherwise varied, the length or width of the structures and/or members or connector or other elements of the system may be varied, the nature or number of adjustment positions provided between the elements may be varied. It should be noted that the elements and/or assemblies of the system may be constructed from any of a wide variety of materials that provide sufficient strength or durability, in any of a wide variety of colors, textures, and combinations. Accordingly, all such modifications are intended to be included within the scope of the present innovations. Other substitutions, modifications, changes, and omissions may be made in the design, operating conditions, and arrangement of the desired and other exemplary embodiments without departing from the spirit of the present innovations.

It will be understood that any described processes or steps within described processes may be combined with other disclosed processes or steps to form structures within the scope of the present disclosure. The exemplary structures and processes disclosed herein are for illustrative purposes and are not to be construed as limiting.

What is claimed is:

1. A laundry appliance, comprising:

a cabinet;

a door rotatably coupled to the cabinet, wherein the door is operable between an opened position and a closed position; and

a door opening assembly coupled to one of the cabinet and the door, wherein the door opening assembly is operable between a first position and a second position, and wherein the door opening assembly includes:

a motor coupled to a support bracket;

a cam having a first end operably coupled with the motor, wherein the cam has a cam rotational axis; and

an actuator arm having a proximal end coupled to the support bracket, wherein the actuator arm has an arm rotational axis, wherein the cam rotational axis is

offset from the arm rotational axis, wherein a second end of the cam is disposed adjacent to a distal end of the actuator arm when the door opening assembly is in the first position, and wherein the second end of the cam is disposed proximate the proximal end of the actuator arm when the door opening assembly is in the second position.

2. The laundry appliance of claim **1**, further comprising:

a biasing member coupled to the actuator arm and the support bracket, wherein the actuator arm is biased towards a disengaged position that corresponds to the first position.

3. The laundry appliance of claim **2**, wherein the cam engages the actuator arm and overcomes a biasing force of the biasing member to move the actuator arm to an engaged position.

4. The laundry appliance of claim **1**, wherein the actuator arm is operable between a disengaged position when the door opening assembly is in the first position and an engaged position when the door opening assembly is in the second position.

5. The laundry appliance of claim **4**, wherein the door opening assembly is coupled to the cabinet, and wherein the actuator arm engages an inner surface of the door when in the engaged position, and wherein a cam surface of the cam and the actuator arm are generally parallel to one another during operation between the first and second positions.

6. The laundry appliance of claim **4**, wherein the door opening assembly is coupled to the door, and wherein the actuator arm engages a front panel surface of the cabinet when in the engaged position.

7. The laundry appliance of claim **1**, wherein each of the cam and the actuator arm rotates to a predefined angle to open the door a predefined distance.

8. The laundry appliance of claim **1**, wherein the actuator arm includes at least one follower.

9. The laundry appliance of claim **8**, wherein the at least one follower includes a first follower coupled to a proximal end of the actuator arm and configured to engage the cam and a second follower coupled to a distal end of the actuator arm and configured to engage one of a door surface and a cabinet surface.

10. The laundry appliance of claim **8**, wherein the at least one follower includes a first follower for contacting the cam and a second follower for contacting the door.

11. The laundry appliance of claim **1**, further comprising:

a controller operably coupled to the motor, wherein the motor is activated via a remote command delivered to the controller.

12. The laundry appliance of claim **1**, wherein the support bracket includes arms to couple to one of the door and the cabinet, wherein a space is defined between the arms, wherein the cam extends out of the space beyond the arms and the actuator arm is disposed entirely out of the space when the door opening assembly is in the second position.

* * * * *